PHOTOSENSITIVE MEMBER CARTRIDGE

This application is a continuation-in-part of co-pending U.S. Patent Application Serial No. 09/281,948, filed on March 31, 1999, the entire disclosure of which is hereby incorporated into this application by reference.

BACKGROUND OF THE INVENTION

1. Field of Invention

The invention relates to a photosensitive member cartridge and a process cartridge for use in an electrostatographic image forming apparatus.

2. Description of Related Art

Some electrostatographic image forming apparatus in which a visible image is obtained by supplying toner to an electrostatic latent image formed on a photosensitive drum, are disclosed in, for example, Japanese Patent Publication Nos. 8-54786 and 9-319285, which correspond to U.S. Patent Nos. 5,845,176 and 5,805,959, respectively.

The former publication discloses such structures that a photosensitive member cartridge including a photosensitive drum, and a developer cartridge including a developing roller, are separately set in a housing.

The latter publication discloses such structures that a photosensitive member cartridge and a developer cartridge are movably connected at one portion by a pin, so that a photosensitive member and a developing roller press against each other.

Generally, the surface of the photosensitive drum is coated with a light-sensitive material. To prevent the surface of the photosensitive drum from being scratched or contaminated, some measures need to be taken. Otherwise, when a portion of the photosensitive surface is scratched or contaminated with, for example, dust, such as would be caused by touching the surface of the photosensitive drum by hand, the photosensitive characteristics of the photosensitive surface are changed. Consequently, the image quality is adversely affected.

Accordingly, a well-known structure, in which the photosensitive drum is covered with a shutter, is employed for apparatus, such as those disclosed in the above-described publications.

However, the shutter needs to be constructed so as to open when the photosensitive member cartridge is set in a body (housing), and so as to close when the photosensitive member cartridge is removed from the body (housing). This makes the structure of the photosensitive member cartridge complicated. In addition, the possibility arises that a user may accidentally open the shutter and touch the surface of the photosensitive member cartridge.

Further, when the photosensitive member cartridge is placed on a table, the shutter may accidentally open, so that the photosensitive drum may be exposed.

SUMMARY OF THE INVENTION

One aspect of the invention is to provide a photosensitive member cartridge that obviates the danger of contamination or scratches on a photosensitive member. To achieve this aspect, the photosensitive member cartridge of the invention includes a case, and a photosensitive member and a transfer roller which are rotatably disposed in the case. The case covers the photosensitive member and the transfer roller. Specially, a bottom wall of the case covers a lower portion of the transfer roller, and upper and rear walls cover the photosensitive member.

The bottom wall extends below the transfer roller. On the extending portion of the bottom wall, a developer cartridge, including a developing roller, is set. Such structures prevent the photosensitive member and the transfer roller from being accidentally touched, which enhances image quality.

Also, it is unnecessary to provide complicated components such as a shutter, so that the structures of the photosensitive member cartridge are simplified.

Further, foot portions provided on the underside of the bottom wall stabilize the photosensitive member cartridge when it is placed on a table.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention will be described in detail with reference to the following figures wherein:

Fig. 1 is a schematic side sectional view of a printer embodying the image forming apparatus of the invention;

Fig. 2 is a side view of the printer, illustrating a situation where the insertion of a process unit into a body housing is started;

Fig. 3 is a plan view of a photosensitive member cartridge;

Fig. 4 is a side sectional view of the photosensitive member cartridge taken on plane IV-IV in Fig. 3;

Fig. 5 is a right side view of the photosensitive member cartridge;

Fig. 6 is a left side view of the photosensitive member cartridge;

Fig. 7 is a front view of the photosensitive member cartridge;

Fig. 8 is a partially cut-away sectional view illustrating a pressing portion of a transfer roller;

Fig 9 is a sectional view taken on plane IX-IX in Fig. 8;

Fig. 10 is a perspective view of an urging device and an action-receiving portion;

Fig. 11(a) is a plan view of a lock device;

Fig. 11(b) is a sectional view taken on line XIb-XIb in Fig. 11(a);

Fig. 12(a) is a left side view of a developer cartridge;

Fig. 12(b) is a right side view of the developer cartridge;

Fig. 13 is a plan view of the developer cartridge;

Fig. 14 is a view of the developer cartridge taken in the direction indicated by arrows XIV in Fig. 13;

Fig. 15 is a sectional view of the developer cartridge, illustrating the structure of shaft bearings disposed at the right and left sides of the developer cartridge;

Fig. 16 is a plan view of a process unit;

Fig. 17 is a right side view of the process unit;

Fig. 18 is a left side view of the process unit;

Fig. 19 is a view of the process unit taken in the direction indicated by arrows XIX in Fig. 17;

Fig. 20(a) illustrates a situation in which the process unit is being inserted into the body housing;

Fig. 20(b) illustrates a situation in which the process unit is further inserted;

Fig. 21 illustrates a situation in which the process unit has been set in the body housing;

Fig. 22 is an illustration of a drive system of the printer;

Fig. 23 is a plan view of the process unit showing the upper register roller 12a provided so as to expose its surface from the bottom opening 300a of the case 30;

Fig. 24 is an enlarged view of the circled portion B of Fig. 23;

Figs. 25A-25I are views showing the register roller 12a and bearings 700, 710;

Figs. 26A-26D are views showing the bearings 700, 710 and the supporting portion 300b of the case 30;

Fig. 27A-27F are views showing the bearing 700;

Figs. 28A-28E are views showing the bearing 710;

Fig. 29 is a view showing the bearing 700 with a bearing chamfered portion 700f and side wall 300c with a gap 300e;

Fig. 30 is a view showing the register roller 12a, and bearings 700, 710;

Fig. 31 is a view showing the register rollers 12a, 12b, bearing 700 and spring 45; and

Fig. 32 is an illustration of a force that presses a developing roller against a photosensitive drum and other forces concerned.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A preferred embodiment in which the invention is embodied in a laser beam-type printer will be described in detail hereinafter with reference to the accompanying drawings. Fig. 1 is a schematic side sectional view of a printer embodying the image forming apparatus of the invention. Fig. 2 is a partly cut-away side view of the printer, illustrating a situation where the insertion of a process unit 2 into a body housing 1 is started.

Referring to Fig. 1, the process unit 2 having a photosensitive member cartridge 3 and a developer cartridge 4 is removably disposed in a substantially

central portion of the body housing 1 of the printer. As shown in a left portion of Fig. 1, a fixer 5 is disposed adjacent to the process unit 2. A sheet feeder 6 is disposed below the process unit 2. A sheet cassette 8 is attachable to a lower portion of the body housing 1 by moving the sheet cassette 8 from a front face of the body housing 1 (as indicated by arrow A).

A laser scanning unit 7 is mounted to a lower surface of a synthetic resin-made discharge sheet tray 1a, via a frame. The discharge sheet tray 1a also serves as a cover.

When print data is transmitted to the printer from an external apparatus, for example, a personal computer, upon a print instruction, a sheet P (recording medium) is separated from a stack of sheets P on a support plate 9 of the sheet cassette 8 by a separator pad 11, in a manner of one sheet at a time, as a sheet feed roller 10 of the sheet feeder 6 rotates. The separated sheet P is conveyed to a contact portion between a photosensitive drum 13 (photosensitive member) in the process unit 2 and a transfer roller 14 (transfer device) pressed against a lower face of the photosensitive drum 13, via a pair of register rollers 12a, 12b.

A laser beam is emitted from the laser scanning unit 7 having a laser light-emitting portion, a polygon mirror 18, a lens 19, a plurality of reflecting mirrors 20 and the like, through a light-emitting hole formed in a lower portion of the frame supporting the laser scanning unit

7. The laser beam travels to an upper peripheral surface portion of the photosensitive drum 13, via a light entrance portion 31 formed in a case 30 of the photosensitive member cartridge 3, that is, a case of the process unit 2. The peripheral surface of the photosensitive drum 13 is thereby exposed corresponding to the print data, so as to form an electrostatic latent image.

Developer (toner) supplied from a developing roller 22 of the developer cartridge 4 becomes deposited on the electrostatic latent image on the photosensitive drum 13, thereby making the image visible. After the visible image formed by developer (toner) is transferred from the photosensitive drum 13 to the sheet P, the sheet P is conveyed between a heat roller 15 and a presser roller 16 in the fixer 5, in which the sheet P is subjected to a heat-fixing process. The sheet P is then discharged onto the discharge sheet tray 1a via a sheet discharge passage 17.

In this embodiment, the process unit 2 includes the photosensitive member cartridge 3 having at least the photosensitive drum 13, and the developer cartridge 4 having at least the developing roller 22 (developing device) that is disposed in a case 21. The developer cartridge 4 is designed so that the developer cartridge 4 is detachably attachable to the photosensitive member cartridge 3, and so that the developing roller 22 is

prevented from detaching by a lock device 46 described later.

The structures of the photosensitive member cartridge 3 and the developer cartridge 4 will be described in detail. As shown in Figs. 3 through 7, the synthetic resin-made case 30 in the photosensitive member cartridge 3 is integrally formed with a bottom wall 30a, a pair of side walls 30c extending upwardly from the right and left sides of the bottom wall 30a, an upper wall 30b connecting the upper edges of the pair of side walls 30c, and a rear wall 30e connected to one side of the upper wall 30b, an end of each of the right and left side walls 30c, and one side of the bottom wall 30a. The photosensitive drum 13 is set in the case 30 near one side thereof, that is, in an area that is surrounded with the upper wall 30b, the rear wall 30e, the right and left side walls 30c, and the bottom wall 30a. The photosensitive drum 13 is rotatably journaled in the right and left side walls 30c. The right and left side walls 30c and the bottom wall 30a extend forward of the photosensitive drum 13.

As shown in Fig. 4, a lower portion of the transfer roller 14 disposed below the photosensitive drum 13 is covered with the bottom wall 30a of the case 30. The transfer roller 14 is vertically movably journaled in such a manner that the transfer roller 14 can separate from a lower surface of the photosensitive drum 13 due to the weight of the transfer roller 14. When the process

unit 2 is set into the body housing 1, the transfer roller 14 contacts the lower surface of the photosensitive drum 13. More specifically, upwardly open "U"-shaped bearings 35 fitted to both end portions of the shaft 14a of the transfer roller 14 are raised by shaft bearing raisers 34 (see Figs. 8 and 9) that are urged upward by springs 33 disposed at the right and left side inner faces of the body housing 1, so that the transfer roller 14 is moved upward to press the lower surface (transfer region) of the photosensitive drum 13. On the other hand, when the process unit 2 is removed from the body housing 1, the transfer roller 14 separates from the photosensitive drum 13 without receiving the action of the springs 33.

The upper wall 30b of the case 30 covers an upper portion of the photosensitive drum 13. The light entrance portion 31, allowing irradiation of an upper surface of the photosensitive drum 13 with laser light emitted from the laser scanning unit 7, is formed in the upper wall 30b, and is elongated in the directions of an axis of the photosensitive drum 13. Disposed adjacent to the light entrance portion 31 is a charger 36, such as a scorotron or the like, that charges a photosensitive surface of the photosensitive drum 13. An electrostatic latent image is formed on the surface of the photosensitive drum 13 by scanning laser light over the surface of the photosensitive drum 13 uniformly charged by the charger 36. After the electrostatic latent image

is made visible (developed) by deposition thereon of a thin layer of toner supplied via the developing roller 22, the toner image is transferred to the sheet P fed in between the photosensitive drum 13 and the transfer roller 14, which press against, and contact with, each other.

A portion of the case 30, other than the upper wall 30b, is open upward. The portion is defined by the right and left side walls 30c, and the bottom wall 30a having a curved surface with a substantially quarter of a circle. The upwardly open portion is an accommodating portion 32 into which the developer cartridge 4 can be set at an angle from above.

With the above-described structures, almost all of the outer surfaces of the photosensitive drum 13 are covered with the rigidly and integrally formed case 30, so that stability, when an operator handles the photosensitive drum 13 by hand, is increased.

Since the bottom wall 30a of the case 30 extends toward the direction away from the photosensitive drum 13, the circumference of the photosensitive drum 13 is not touched, even when the operator holds the extending portion of the bottom wall 30a. Therefore, when the operator handles the photosensitive member cartridge 3 by hand, the photosensitive surface of the photosensitive drum 13 remains untouched, so that the surface of the photosensitive drum 13 will not be contaminated and instead will always be kept clean.

In particular, when the developer cartridge 4 is connected to the photosensitive member cartridge 3, the bearings 23a, 23b contact and move along a first section of the guide grooves 37 in a direction that includes a vertical component. The bearings 23a, 23b then contact and move along a second section of the guide grooves 37 in a direction that is substantially horizontal. The difference of direction of movement of the bearings 23a, 23b is due to the arcuate shape of the guide grooves 37. Also, because of this arcuate shape, the bearings 23a, 23b move faster along the first section of the guide grooves then along the second section.

An urging device 42 that presses the developing roller 22 against the photosensitive drum 13 via the developer cartridge 4 is pivotably and expandably mounted to an inner surface of each of the right and left side walls 30c. As shown in Figs. 4 and 10, each urging device 42 has a pivot fulcrum member 39 provided with pivots 39a, 39b protruding integrally from the right and left sides thereof, a frame-like slide support member 40 that connects with and supports the pivot fulcrum member 39 that facilitates sliding movements therein, and an urging spring device 41, such as a coil spring or the like, that is disposed in the frame of the slide support member 40 so as to urge the pivot fulcrum member 39 toward one end. The slide support member 40 has a cylindrical motion acting portion 43 extending laterally. The motion acting portion 43 of each urging device 42 is

disposed so that the portion 43 protrudes outward from a guide hole 44 formed in the corresponding one of the right and left side walls 30c.

The lock device 46 that prevents the developer cartridge 4, which is fitted into the accommodating portion 32, from moving upward out of the accommodating portion 32, is disposed at an inner side of one of the right and left side walls 30c (the right side wall in the embodiment) of the photosensitive member cartridge 3. As shown in Figs. 4, 5, 11(a) and 11(b), the lock device 46 is designed so that a rotating shaft 48 extending through the side wall 30c axially supports a lock lever 47 in such a manner that the lock lever 47 is pivotable relative to a side surface of the lock lever 47.

A resin-made spring 49 extending downward from a lower end of the lock lever 47 is disposed so that a lower portion of the resin-made spring 49 contacts a restriction piece 30d protruding upward from the bottom wall 30a of the case 30. A lower surface of the lock lever 47 has an arched contact portion 47a that restricts upward motion of one of action-receiving portions 61 (right-side one) protruding outward from the right and left side surfaces of the case 21 of the developer cartridge 4, by contacting an upper surface of the action-receiving portion 61. The action-receiving portions 61 have a generally inverted triangular shape in side view.

The action-receiving portions 61 are disposed so that they communicate with the lock device 46 and, furthermore, urging devices 42 that press the developing roller 22 against the photosensitive drum 13.

Rollers 50 are disposed, as receiving members, at a plurality of positions (two positions in the embodiment, that is, at right and left end portions) in the bottom wall 30a of the case 30, in the accommodating portion 32 of the photosensitive member cartridge 3 (see Figs. 3 and 4). The rollers 50 protrude from the inner surface of the bottom wall 30a. When the developer cartridge 4 is inserted down into the accommodating portion 32, the rollers 50 (receiving device) receive a portion of the weight of the developer cartridge 4, at a side across the developing roller shaft 22a of the developing roller 22 from the photosensitive drum 13, that is, a side of the developing roller shaft 22a of the developing roller 22 opposite from the photosensitive drum 13. More specifically, the rollers 50 contact lower portions of a downward-convex curved surface of a toner containing chamber 24 (see Figs. 1, 12(a) and 12(b)) formed in the case 21 of the developer cartridge 4, and the rollers 50 reduce the rattling of the case 21 during the setting or removing operation.

The upper roller 12a of the pair of register rollers is mounted to the bottom wall 30a of the case 30 of the photosensitive member cartridge 3 in such a manner that the upper roller 12a is prevented from detaching. The

bottom wall 30a has a laterally elongated introduction hole 51 adjacent to the upper roller 12a, to introduce the sheet P from the pair of register rollers 12a, 12b into a transfer portion 52 between the photosensitive drum 13 and the transfer roller 14. The upper surface of a portion of the bottom wall 30a extending between the introduction hole 51 and the transfer portion 52 has many ribs 53 extending in a direction from the introduction hole 51 to the transfer portion 52. The ribs 53 are designed so that the sheet P can be smoothly conveyed with a reduced contact resistance on the lower surface of the sheet P.

A discharge hole 51b is formed between the bottom wall 30a and the rear wall 30e of the case 30, to convey the sheet P between a heat roller 15 and a presser roller 16, through the transfer portion 52 (see Fig. 4).

The structure of the developer cartridge 4 will be described with reference to Figs. 1, 12a, 12b and 13 through 15. After toner in the downward-convex toner containing chamber 24 in the case 21 is stirred by a rotationally driven stirrer 27 and discharged therefrom, toner is carried onto the outer peripheral surface of the developing roller 22 via a supply roller 25. A blade 26 is provided for restricting the layer thickness of toner on the developing roller 22 (see Fig. 1). The generally inverted triangular-shaped action-receiving portions 61 protrude from the right and left side outer ends of the toner containing chamber 24 in the case 21.

The shaft bearings 23a, 23b rotatably fitted to the right and left end portions of the developing roller shaft 22a are formed from a material whose friction coefficient is small, such as an acetal resin or the like. Each of the bearings 23a, 23b has an engaging nail 62 that engages with an annular groove 63 so that the bearing will not detach from the shaft end. Each of the shaft bearings 23a, 23b has, at its base end side, an umbrella-shaped (conical) shaft diameter adjusting portion 64 whose diameter gradually increases.

At least one of the shaft bearings 23a, 23b (the right-side bearing 23b in the embodiment) is slidingly urged laterally outward by a spring device 65 (see Fig. 15). Therefore, when the developer cartridge 4 is set at a predetermined position with respect to the photosensitive member cartridge 3, the developing roller shaft 22a of the developing roller 22 are supported, without rattling, on the guide grooves 37 formed in the right and left side walls 30c of the photosensitive member cartridge 3.

As shown in Figs. 16 and 19, the case 21 of the developer cartridge 4 has, in an upper surface portion and a lower surface portion thereof, grip portions 70, 66, respectively, that facilitate the handling of the developer cartridge 4 by an operator.

Further, as shown in Figs. 17 and 18, the case 30 of the photosensitive member cartridge 3 has foot portions 69a, 69b at the lower portions thereof, so that the

photosensitive member cartridge 3 can be stably placed on the table 67 regardless of whether the photosensitive member cartridge 3 stands alone or is combined with the developer cartridge 4. The foot portions 69a, 69b need to be provided diagonally at at least two positions and, preferably, four positions at each corner of the case 30, as in the embodiment. More foot portions 69a, 69b may be provided if the space is available on the case 30.

In the embodiment, as shown in Figs. 5-7, 17, and 18, when the photosensitive member cartridge 3 is viewed from the side, the foot portions 69a, 69b are provided so as to extend downwardly, at the lower portions of the case 30 near both ends of the forward and rearward sides thereof. The foot portions 69a, 69b contact the table 67 with the center of gravity of the photosensitive member cartridge 3 placed between the foot portions 69a, 69b, so that the photosensitive member cartridge 3 is stabilized when it is placed on the table 67.

The case 30 is formed with the upwardly open accommodating portion 32 near one side thereof. The developer cartridge 4 can be removably set into the accommodating portion 32 from above, while the photosensitive member cartridge 3 is placed on the flat surface of the table 67 in a stable posture via the foot portions 69a, 69b. Therefore, replacement of the developer cartridge 4 can be easily performed.

Preferably, the foot portions 69a, 69b are provided at the forward and rearward sides of the case 30, so as

to place the centers of gravity of both the developer cartridge 4 and the photosensitive member cartridge 3 between the foot portions 69a, 69b. With such arrangements, the developer cartridge 4 can be set in the photosensitive member cartridge 3, which is placed on the table 67, without causing unstable actions of the photosensitive member cartridge 3, such as swinging. Further, Fig. 7 shows the foot portions 69a, 69b provided at the right and left side end portions of the lower surface of the case 30. The foot portions 69a, 69b may be provided at the lowermost portions of the case 30 so as to protrude toward the left and right sides.

The operation of setting the developer cartridge 4 with respect to the photosensitive member cartridge 3 will be described. To set the developer cartridge 4 with respect to the photosensitive member cartridge 3, an operator holds with one hand, the grip portions 70, 66 formed on an upper surface portion and a lower surface portion of the case 21 of the developer cartridge 4. When the developer cartridge 4 is inserted, with the developing roller 22 side being a leading side, into the accommodating portion 32 of the case 30 (inserting operation), one of the action-receiving portions 61 of the developer cartridge 4 contacts the lock lever 47, and turns the lock lever 47 to a position indicated by a two-dot line in Fig. 4, against the force of the resin-made spring 49. When the developer cartridge 4 is thus inserted (the inserting operation is completed), the

action-receiving portion 61 is lowered and, therefore, the contact between the action-receiving portion 61 and the lock lever 47 discontinues. Therefore, the lock lever 47 is returned to the position indicated by a solid line in Fig. 4, by the restoration force of the resin-made spring 49, so that the contact portion 47a of the lock lever 47 faces an upper surface of the action-receiving portion 61, thereby establishing a locked state. The process unit 2 integrated with the developer cartridge 4 and the photosensitive member cartridge 3, can be raised with one hand by holding the grip portions 70, 66. That is, the operator sequentially can set the process unit 2 into a predetermined portion of the body housing 1 while holding the grip portions 70, 66 after the developer cartridge 4 is set with respect to the photosensitive member cartridge 3.

During the insertion of the developer cartridge 4 into the accommodating portion 32, the shaft bearings 23a, 23b disposed at the right and left side ends of the developing roller 22 slide down along the guide grooves 37 formed along the upper edges of the right and left side walls 30c of the case 30, so as to approach the shaft 13a of the photosensitive drum 13. The case 21 of the developer cartridge 4 is pivotable about the bearings 23a, 23b of the developing roller shaft 22a of the developing roller 22 when the bearings 23a, 23b are supported by the guide grooves 37. Therefore, when the bearings 23a, 23b come to a position on the guide grooves

37 close to the shaft 13a of the photosensitive drum 13 ("U"-shaped portions of the guide grooves 37), a toner containing chamber 24 side portion of the case 21 of the developer cartridge 4 comes into the accommodating portion 32 of the photosensitive member cartridge 3 by a pivoting motion about the developing roller shaft 22a of the developing roller 22. Thus, the developer cartridge 4 is fittingly set in the accommodating portion 32.

In this state, the rollers 50 provided on the inner surface of the accommodating portion 32 slidingly contact a lower surface portion of the case 21 on the side of the toner containing chamber 24, and the bearings 23a, 23b move along the guide grooves 37 to such a position that the developing roller 22 is located substantially closest to the photosensitive drum 13. When the lock lever 47 pivots clockwise to return from the position indicated by the two-dot line to the position indicated by the solid line in Fig. 4, the contact portion 47a of the lock lever 47 faces the upper surface (protrusion 61a) of the action-receiving portion 61, so that the developer cartridge 4 is prevented from moving out of the photosensitive member cartridge 3.

Figs. 16 through 19 are a plan view, a right side view, a left side view, and a rear view (a view of the side of the sheet discharge opening) of the process unit 2 with the developer cartridge 4 set with respect to the photosensitive member cartridge 3. Since the urging devices 42 are pressed downward by the action-receiving

portions 61 as the developer cartridge 4 is pushed downward into the process unit 2, each urging device 42 normally assumes such a orientation that the motion acting portion 43 is relatively lowered, as shown in Figs. 2 and 4.

The process unit 2 is designed so that the process unit 2 can be set into, and removed from, the body housing 1 when a lid 1b provided in the right-side end in Fig. 1 (a front face) of the body housing 1 is downwardly turned to form a large opening (see Fig. 2).

That is, as shown in Figs. 2, 20(a), 20(b) and 21, a pair of right and left guide devices 55, made of a resin or the like, are fixed to the inner surfaces of the right and left side portions of the body housing 1 (in the drawings, only the right-side guide device 55 is shown). Each guide device 55 has a rising slope surface that is open upward and extends upwardly inward from the right-side end of the body housing 1, and an upper-side guide surface 55a extending downwardly inward from a summit 55d of the rising slope surface, and a lower-side guide surface 55b that is disposed below the upper-side guide surface 55a and that extends downwardly inward from the right-side end of the body housing 1, and ends at a position near the lower roller 12(b) of the pair of register rollers.

Fig. 2 indicates a position at which the insertion of the process unit 2 into the body housing 1 is started. The process unit 2 is inserted into the body housing 1 so

that the shaft 13a of the photosensitive drum 13 approaches an upper inward end portion 55c of the upper-side guide surface 55a. Subsequently, as shown in Fig. 20(a), the motion acting portion 43 of each urging device 42 contacts the rising slope surface of the upper-side guide surface 55a, and each of guiding members 56, protruding laterally from lower portions of the right and left sides of the process unit 2 (photosensitive member cartridge 3), fits into the lower-side guide surface 55b (only one of the guiding members 56 is shown in the drawings), so that the process unit 2 is prevented from moving upward relative to the body housing 1, and is allowed only to be moved further inward along the lower-side guide surface 55b.

In this state, as the process unit 2 is pushed inward, the motion acting portion 43 of each urging device 42 is raised by the corresponding upper-side guide surface 55a, so that the slide support member 40 of each urging device 42 pivots upward about the pivots 39a, 39b. Therefore, the slide support member 40 of each urging device 42 restrains the corresponding one of the action-receiving portions 61 of the developer cartridge 4 in such a direction that a distal end portion of the slide support member 40 pushes the action-receiving portion 61. When the motion acting portion 43 of each urging device 42 comes to the summit 55d of the upper-side guide surface 55a, the slide support member 40 of each urging device 42 is pivoted to a most upward orientation. In

this orientation, the distal end portion of the slide support member 40 of each urging device 42 keeps restraining the corresponding action-receiving portion 61 (see Fig. 20(b)).

As the process unit 2 is pushed further inward, the shaft 13a of the photosensitive drum 13 is set to a predetermined position in the inward end portion 55c of each upper-side guide surface 55a. At this position, an operator releases the process unit 2 from the hands, so that the developer cartridge 4 side portion of the process unit 2 is lowered and set by the weight the process unit 2 into a state such that the upper register roller 12a disposed at a lower surface side of the case 30 of the photosensitive member cartridge 3 is placed on the lower register roller 12b disposed in the body housing 1, and is pressed by a spring 45 shown in Fig. 2 and, simultaneously, the guiding members 56 are supported at appropriate positions on the guide devices 55 (see Fig. 21).

When the process unit 2 is set as described above, the distal end of the slide support member 40 of each urging device 42 presses the corresponding action-receiving portion 61. Therefore, the developing roller 22 is pressed against the photosensitive drum 13 by the urging devices 42 and the action-receiving portions 61 via the developer cartridge 4.

As shown in Fig. 21, it is preferable that a contact portion 72a between the photosensitive drum 13 and the

developing roller 22, that is, pressed portions thereof at the closest positions, (the contact portion 72a is on an inter-axis straight line 72 passing through the axis of the shaft 13a of the photosensitive drum 13 and the axis of the developing roller shaft 22a of the developing roller 22) be above or on a pressing action line 71 of the action of either one of the urging devices 42 onto the corresponding action-receiving portion 61 (that is, a straight line passing through the pivot 39a (39b) and a pressing point at which the distal end of the slide support member 40 contacts the action-receiving portion 61), or that the inter-axis straight line 72 substantially coincide with or extend substantially parallel to the pressing action line 71.

As shown in Fig. 22, a gear mechanism 74 that transmits force from a drive motor 73 is disposed on the inner surface of one side (the left side in the embodiment) of the body housing 1. The gear mechanism 74 rotates the sheet feed roller 10 of the sheet feeder 6, the lower register roller 12b, the developing roller 22, the photosensitive drum 13, the heat roller 15, and conveying rollers in the sheet discharge passage. The developing roller 22 and the photosensitive drum 13 are rotated in opposite directions, as indicated in Figs. 1 and 21, that is, the developing roller 22 is rotated counterclockwise and the photosensitive drum 13 is rotated clockwise. Furthermore, the mechanism is designed so that the circumferential velocity of the

developing roller 22 is greater than that of the photosensitive drum 13.

Therefore, as shown in Fig. 32, during image forming operation, the direction of a pressing force F1 of each urging device 42 acting on the contact portion 72a is parallel to the pressing action line 71, and the pressing force F1 is split into a component F1V in a direction of the tangent of the circumferences of the developing roller 22 and the photosensitive drum 13 and a component F1H in a direction of the inter-axis straight line 72.

The difference in circumferential velocity between the developing roller 22 and the photosensitive drum 13 creates a friction resistance force F2 in an upward direction in Fig. 32 with respect to the developing roller 22 and in a downward direction with respect to the photosensitive drum 13, the friction resistance force F2 having a value equal to a multiplication product of the friction coefficient and the component F1H of the pressing force in the direction of the inter-axis straight line 72 of the photosensitive drum 13 and the developing roller 22. Therefore, the rotation moment caused by the friction resistance force F2 acting on the developer cartridge 4 acts about the developing roller shaft 22a in a clockwise direction in Fig. 32.

If the pressing action line 71 extends above the developing roller shaft 22a, a rotation moment acts on the developer cartridge 4 about the developing roller shaft 22a counter clockwise in Fig. 32, and reduces or

offsets the rotation moment caused by the friction resistance force F2. In such a case, the developer cartridge 4 tends to rise, which is unfavorable. In this invention, however, the position of the developing roller shaft 22a is above or on the pressing action line 71, or the inter-axis straight line 72 substantially coincides with, or extend substantially parallel to, the pressing action line 71. Therefore, during image formation, the developing roller 22 is substantially prevented from rising, and stable pressing action can be achieved.

Furthermore, the pressing structure is formed by the urging devices 42 for pressing the developing roller 22 against the photosensitive drum 13, and the action-receiving portions 61 provided on the developer cartridge 4. The action-receiving portions 61 are disposed at a side of the developing roller 22, the side being remote from the photosensitive drum 13. Therefore, the photosensitive drum 13, the developing roller 22 and the drive mechanisms will not become impediments, and the pressing action line 71 and the inter-axis straight line 72 can easily be set substantially parallel to each other and adjacent to each other.

If the developer cartridge 4 is supported pivotably about the developing roller shaft 22a of the developing roller 22 while image forming operation is being performed, with the developer cartridge 4 set with respect to the photosensitive member cartridge 3, that is, if the arrangement is set such that during image

forming operation, the bearings 23a, 23b on both ends of the developing roller shaft 22a of the developing roller 22 are stopped at the inward sides of the guide grooves 37 of the photosensitive member cartridge 3 and therefore prevented from moving further inward, and the weight Wo of the developer cartridge 4 is dispersedly supported at two positions in a side view, that is, the position of the shaft bearing 23a (23b), and a position at a side of the developing roller shaft 22a remote from the photosensitive drum 13, for example, a position at which the bottom of the toner containing chamber 24 contacts the rollers 50, or the like, so that split loads W1, W2 of the weight Wo are supported at the two positions (see Fig. 32), then the direction of the rotation moment about the axis (the developing roller shaft 22a) of the developing roller 22 caused by the friction resistance force F2 received by the developing roller 22 from the photosensitive drum 13 becomes the same as the direction of the rotation moment about the axis (the developing roller shaft 22a) of the developing roller 22 caused by the weight (load Wo at the center of gravity G) of the developer cartridge 4, that is, the clockwise direction in Fig. 32. Therefore, during image forming operation, the aforementioned friction resistance force F2 does not act as a moment in such a direction as to raise the developer cartridge 4 against the weight (load Wo at the center of gravity G) of the developer cartridge 4, so

that the behavior of the developer cartridge 4 stabilizes.

In the above-described structure, the urging devices 42 are disposed at positions that are within the accommodating portion 32 in the photosensitive member cartridge 3, and that become remote from the developing roller 22 of the developer cartridge 4 when the developer cartridge 4 is set in the accommodating portion 32. The action-receiving portions 61 protrude outward from outer walls of the developer (toner) containing chamber 24, which is disposed at a side remote from the developing roller 22. Therefore, these component parts are unlikely to interfere with the operations of inserting or removing the developer cartridge 4.

In the embodiment of the invention, the urging devices 42, having a relatively complicated structure are disposed in the photosensitive member cartridge 3, which requires less frequent replacement. The action-receiving portions 61 having a relatively simple structure, are disposed in the developer cartridge 4, which requires frequent replacement. Therefore, the production costs of the process unit 2 and the developer cartridge 4 can be reduced, and the running cost can be reduced. Furthermore, since the protruded action-receiving portions 61 provided on the developer cartridge 4 are integral with the side surfaces of the case 21, the action-receiving portion 61 can be formed together with the case 21, thereby reducing the production cost and,

further, making it easier for the action-receiving portions 61 to be pressed by the slide support members 40 of the urging devices 42 provided on the photosensitive member cartridge 3.

The right and left urging devices 42 are disposed on inner surfaces of the right and left sides of the photosensitive member cartridge 3, and are connected thereto in such a manner that the urging devices 42 are capable of changing the orientation between a direction of the urging force thereof and a non-urging direction. Therefore, if the developer cartridge 4 is simply placed over or adjacent to the photosensitive member cartridge 3, the developing roller 22 is not pressed against the photosensitive drum 13. Hence, the photosensitive member cartridge 3 and the developer cartridge 4 can be combined as a process unit 2 for packing and shipping, while obviating the danger of permanent deformation of the outer peripheral surface of the process unit 2, or the danger of contamination of the photosensitive drum 13 with material components from the developing roller 22.

Still further, since each urging device 42 is substantially made up of the pivot fulcrum member 39, the slide support member 40 slidable relative to the pivot fulcrum member 39, and the urging spring device 41 disposed between the two members, the urging devices 42 gain an increased degree of freedom in changing the orientation between the urging direction and the non-urging direction, compared with a conventional device

that employs an urging spring to directly press an action-receiving portion and discontinue the pressing. Another advantage that the operations of pressing the action-receiving portions 61, and discontinuing the pressing, can be reliably performed by the slide support members 40 can also be achieved.

Further, since each urging device 42 is rotatably connected at its pivot fulcrum member 39 to the inner surface of the right or left side of the case 30 of the photosensitive member cartridge 3, most of the component parts of the urging devices 42 are unexposed outside the case 30, regardless of whether the photosensitive member cartridge 3 stands alone or is combined with the developer cartridge 4 into the process unit 2. Therefore, the danger of accidentally hitting and breaking any component part of the urging devices 42 is considerably reduced, and the ease of handling improves.

The slide support member 40 of each urging device 42 is provided integrally with the pin-like motion acting portion 43 protruding laterally to guide the slide support member 40 into the urging direction and the non-urging direction. The motion acting portions 43 of the urging devices 42 protrude outward from guide holes 44 in the right and left sides of the case 30 of the photosensitive member cartridge 3. Thus, most of the component parts of the urging devices 42 are unexposed outside the case 30. Therefore, the danger of accidentally hitting and breaking any component part of

the urging devices 42 is considerably reduced, and the ease of handling improves.

The action-receiving portions 61 protruding outwardly from the right and left sides of the case 21 of the developer cartridge 4 perform the function to be pressed by the urging devices 42 and the function to cooperate with the lock lever 47 of the lock device 46 to prevent the developer cartridge 4 from rising relative to the photosensitive member cartridge 3. Since the action-receiving portions 61 thus perform the two functions, the predetermined cost of the developer cartridge 4 can be considerably reduced.

The process unit 2 is designed so as to be removably set into the body housing 1 of the image forming apparatus. The body housing 1 is provided with the guide devices 55 that guide the urging devices 42 and switch the urging devices 42 between the urging state and the non-urging state. Therefore, the orientation of the urging devices 42 and the operation thereof will be changed or switched simply by setting the process unit 2 into the body housing 1 or removing the process unit 2 from the body housing 1. Thus, the ease of operation considerably improves.

The upper wall 30b of the case 30 covers an upper portion of the photosensitive drum 13. The rear wall 30e, extending downwardly from the upper wall 30b, covers a rear portion of the photosensitive drum 13. The bottom wall 30a covers a lower portion of the transfer roller 14

disposed below the photosensitive drum 13. Therefore, exposed portions on the photosensitive drum 13 are very small. The right and left side walls 30c cover each end of the transfer roller 14 and the photosensitive drum 13. The case 30 is rigidly and integrally formed of synthetic resin, so that an operator will not touch the surface of the photosensitive drum 13. The case 30 also prevents dust from adhering to the photosensitive drum 13. The operator can securely handle the photosensitive drum 13.

Further, the bottom wall 30a of the case 30 extends toward the direction away from the photosensitive drum 13. Holding such an extending portion of the bottom wall 30a and the rear wall 30e by both hands, an operator will not touch the photosensitive drum 13, and can stably handle the photosensitive member cartridge 3. While the operator is holding the extending portion of the bottom wall 30a and the rear wall 30e, the bottom wall 30a does not flex since the case 30 is a rigid body having a cross-sectional profile which is substantially concave, with the bottom wall 30a connected to the right and left side walls 30c of the case 30. Therefore, the case 30 can be securely handled.

Also, the light entrance portion 31, allowing irradiation of an upper surface of the photosensitive drum 13 with laser light emitted from the laser scanning unit 7, and the charger 36 that charges a photosensitive surface of the photosensitive drum 13 provided in the upper wall 30b, make the case 30 sturdy.

Since the upwardly open accommodating portion 32 is formed by extending the bottom wall 30a and the right and left side walls 30c to accommodate the developer cartridge 4 therein, the handling of the photosensitive member cartridge 3 with the developer cartridge 4 set therein can be easily performed.

The accommodating portion 32 covers the lower surface and the peripheral surfaces of the developer cartridge 4 when the developer cartridge 4 is set therein. Also, the accommodating portion 32 is open upwardly, so that the case 21 of the developer cartridge 4 set in the accommodating portion 32 is detached therefrom in such a direction that the developing roller 22 travels away from the photosensitive drum 13. Thus, the operation of setting the developer cartridge 4 into the accommodating portion 32, or removing the developer cartridge 4 from the accommodating portion 32, can be easily performed.

The bottom wall 30a has an introduction hole 51a to introduce the sheet P. The upper surface of a portion of the bottom wall 30a has many extending ribs 53 to smoothly convey the sheet P from the introduction hole 51a to the contact portion, between the lower surface of the photosensitive drum 13 and the upper surface of the transfer roller 14. The ribs 53 guide the sheet P and increase the rigidity to the bottom wall 30a. When the developer cartridge 4 is set into the accommodating portion 32, the ribs 53 face the lower surface of the

developer cartridge 4. The space between the ribs 53 and the lower surface of the developer cartridge 4, becomes the path of the sheet P. Thus, the sheet conveying structures are simplified.

If the area of the bottom wall 30a covering the lower portion of the transfer roller 14 is increased, the wider portions of the exposed surfaces of the transfer roller 14 and the photosensitive drum 13 are covered, without increasing resistance when the sheet P is conveyed, since the introduction hole 51a and the discharge hole 51b are provided.

Even if the photosensitive member cartridge 3 remains removed from the body hosing 1 for a long time, the danger of permanent deformation of the outer peripheral surface of the transfer roller 14, or the danger of contamination of the photosensitive drum 13 with chemicals from the transfer roller 14, is obviated, since the photosensitive member cartridge 3 has the rigid case 30 on the peripheral surface thereof.

When the case 30 is set in a predetermined position with respect to the body housing 1, the bearings 35 fitted to both end portions of the transfer roller 14 are raised by the shaft bearing raisers 34 and the springs 33, so that the transfer roller 14 is moved upward to press the photosensitive drum 13. By the simple operation of setting the case 30 into the body housing 1, or removing the case 30 from the body housing 1,

pressures can be applied to, or removed from, the transfer portion 52.

When the photosensitive member cartridge 3 is removed from the body housing 1, the transfer roller 14 separates from the lower surface of the photosensitive drum 13 due to the weight of the transfer roller 14. Therefore, even when a sheet P becomes jammed at the transfer portion 52, the sheet P restrained at the transfer portion 52 can be released by only removing the photosensitive member cartridge 3 from the body housing 1. Then, by removing the sheet P from the transfer portion 52 through the introduction hole 51a, or the discharge hole 51b, the paper jam can be easily cleared.

Register rollers 12a, 12b are a pair of rollers to convey the sheet P supplied from the sheet feeder 6 to the contact portion between the photosensitive drum 13 and the transfer roller 14, while timing is being provided. The upper register roller 12a is provided on the side of the process unit 2. The lower register roller 12b is provided on the side of the body housing 1. In this embodiment, the process unit 2 is designed so that the process unit 2 can be removably set in the body housing 1 from the front face thereof. When both register rollers 12a and 12b are provided to the body housing 1 as in a conventional apparatus, a portion of the case 30 covering the transfer roller 14 comes into contact with the upper register roller 12a when the process unit 2 is removed from the front face of the body

housing 1, as can be seen from Fig. 1. This makes the removal of the process unit 2 from the body housing 1 difficult.

By providing the upper register roller 12a on the side of the process unit 2, the removal of the process unit 2 from the front face of the body housing 1 can be facilitated. The process unit 2 is set in the body housing 1 while moving inside the body housing 1 in a direction substantially parallel to the feeding direction of the sheet P conveyed by the pair of register rollers 12a, 12b.

However, when the upper register roller 12a and the lower register roller 12b are provided on the sides of the process unit 2 and the body housing 1, respectively, to facilitate the setting of the process unit 2 into the body housing 1 or the removal of the process unit 2 from the body housing 1, it is important to maintain the appropriate positions, angles, and pressing pressures of the upper and the lower register rollers 12a and 12b with respect to each other to stably convey the sheet P.

Even when the process unit 2 is replaced with a new one, the new process unit 2 needs to be set in the body housing 1 while the appropriate positions, angles, and the pressing pressures of the upper and the lower register rollers 12a and 12b are being maintained with respect to with each other.

In the embodiment, the positioning mechanism of the pair of register rollers 12a, 12b is constructed as described below.

As shown in Fig. 23, the upper register roller 12a is provided so as to expose its surface from the bottom opening 300a of the case 30. Unlike a general roller journaled in the side surfaces of an apparatus body or case, the register roller 12a is provided in the following manner. As shown in Fig. 24, which is a enlarged view of the circled portion B in Fig. 23, protrusions 700a of a bearing 700 fitted to the register roller 12, contact supporting portions 300b integrally formed with the case 30. The register roller 12a is disposed so as to vertically move in the directions indicated by an arrow in Fig. 24 (the direction such that the register roller 12a is pressed against the register roller 12b and the opposite direction).

As shown in Fig. 25B, the register roller 12a is a shaft formed by plated iron or stainless steel. The length of the register roller 12a is longer than the width of the sheet P. Bearings 700, 710 made of resin are disposed to each end of the register roller 12a. As shown in Figs. 25A and 27A through 27F, the bearing 700 is provided with a integrally-formed cylindrical portion 700b with an insertion hole 700c for inserting an end of the register roller 12a and a supporting portion 700d formed with protrusions 700a.

To the other end of the register roller 12a, the bearing 710 is disposed. As shown in Figs. 25C and 28A through 28E, the bearing 710 has substantially the same shape as the bearing 700, except for a cavity 710e. That is, the bearing 710 is provided with a integrally-formed cylindrical portion 710b with an insertion hole 710c for inserting an end of the register roller 12a and a supporting portion 710d formed with protrusions 710a and the cavity 710e, as shown in Fig. 28D. Due to the cavity 710e, the supporting portion 710d is easy to flex inward (toward the central portion thereof), as shown by arrows in Fig. 28D.

After the above-described bearings 700, 710 are fitted to each end of the register roller 12a, as shown in Fig. 25B, the register roller 12a is mounted to the case 30 as described below.

As shown in Fig. 29, the bearing 700 is first inserted into a gap 300e defined between a side wall 300C of the case 30 and a bottom wall 300d that covers an end portion of the register roller 12a, at such an angle indicated in Fig. 29. Then, the bearing 700 is pushed to the direction indicated by the arrow G. As shown in Fig. 29, a chamfered portion 700f having a slanted surface is formed on the upper end portion of the supporting portion 700d above the protrusions 700a. The chamfered portion 700f smoothly makes contact with the corner of the bottom wall 300d, so that the bearing 700 can be smoothly fitted into the gap 300e.

As shown in Figs. 24 and 27D, an inclined surface 720 is formed on the protrusion 700a. The inclined surface 720 smoothly makes contact with the supporting portions 300b, so that the bearing 700 can be easily fitted into the gap 300e. The thus fitted bearing 700 into the gap 300e is shown in Fig. 30.

To fit the bearing 710 into the gap 300e, the supporting portion 710d is flexed inward (toward the central portion thereof) as indicated by the arrows in Fig. 28D. While flexing the supporting portion 710d, so as to narrow the width thereof, the bearing 710 is pushed into the gap 300e. The flexible supporting portion 710d makes the insertion of the bearing 710 into the gap 300e easy. An inclined surface 730 is also formed on the protrusions 710a of the bearing 710, as shown in Fig. 28D. The inclined surface 730 smoothly makes contact with the supporting portions 300b, so that the bearing 710 can be easily fitted into the gap 300e.

Figs. 25D through 25I show the bearings 700, 710 fitted into the gaps 300e in such a manner as described above. As shown in Figs. 25D through 25I, when the register roller 12a is moved up to the highest position where the cylindrical portions 700b, 710b of the bearings 700, 710, respectively, contact the lower ends of the side walls 300c, the further upward movement of the register roller 12a is restricted due to the bearings 700, 710 outwardly extending from the side wall 300c. As shown in Figs. 26A through 26D, which are enlarged views

of the bearings 700, 710 and their periphery shown in Figs. 25G-25I, when the register roller 12a is moved down to the lowest position due to its own weight, the further downward movement of the register roller 12a is restricted by contacting the protrusions 700a, 710a to the supporting portions 300b.

The above-described structure enables the register roller 12a to move freely up and down in the direction such that the register roller 12a separates from and presses against the register roller 12b.

As shown in Fig. 1, the register roller 12b has a shaft 12c formed of plated iron or stainless steel and an elastic layer 12d formed of urethane rubber and which is provided on the shaft 12c. The shaft 12c is rotatably supported in the body housing 1. The shaft 12c is connected to a motor via a gear (not shown). The timing of starting the rotation of the register roller 12b and the speed thereof are controlled by a controller (not shown).

As described above, the register roller 12a is provided so as to vertically move. The register roller 12a is positioned so as to maintain the appropriate position, angle, and the pressing pressure with respect to the register roller 12b, when the process unit 2 is set in the body housing 1.

With reference to Figs. 2, 9, 20A, 20B, 21, and 31, the operation of setting the process unit 2 into the body

housing 1 and the mechanism of positioning the register roller 12a will be described below.

The process unit 2 is set into, and removed from, the body housing 1 when a lid 1b, provided in the right-side end in Fig. 1 (a front face) of the body housing 1, is downwardly turned to form a large opening. As shown in Fig. 2, a pair of right and left guide devices 55, made of resin, are fixed to the inner surfaces of the right and left side portions of the body housing 1. Each guide device 55 has a rising slope surface that is open upward and extends upwardly inward from the right-side end of the body housing 1, and an upper-side guide surface 55a extending downwardly inward from a summit 55d of the rising slope surface, and a lower-side guide surface 55b that is disposed below the upper-side guide surface 55a and that extends downwardly inward from the right-side end of the body housing 1, and ends at a position near the register roller 12b.

Fig. 2 indicates a position at which the insertion of the process unit 2 into the body housing 1 is started. When the process unit 2 is inserted into the body housing 1 from a position shown in Fig. 2 to a position shown in Fig. 20A, the process unit 2 is pushed inward so that the shaft 13a of the photosensitive drum 13 approaches an inward end portion 55c disposed inward from the upper-side guide surface 55a. Subsequently, as shown in Fig. 20A, the motion acting portion 43 of each urging device 42, mounted to the process unit 2, contacts the rising

slope surface of the guide device 55, and each of guiding members 56 (only one of the guiding members 56 is shown in the drawings), protruding laterally from lower portions of the right and left sides of the process unit 2 fits into the lower-side guide surface 55b, so that the process unit 2 is prevented from moving upward relative to the body housing 1, and is allowed only to be moved further inward along the lower-side guide surface 55b.

At this time, the register roller 12a moves downwardly due to its own weight as shown in Fig. 20A, and approaches the register roller 12b while slidingly contacting with the lower-side guide surface 55b.

When the process unit 2 is thus pushed inward, the motion acting portion 43 of each urging device 42 is raised by the corresponding upper-side guide surface 55a, so that the slide support member 40 of each urging device 42 pivots upward about the pivots 39a, 39b. Therefore, the slide support member 40 of each urging device 42 restrains the corresponding one of the action-receiving portions 61 in such a direction that a distal end portion of the slide support member 40 pushes the action-receiving portion 61, as shown in Fig. 20B. When the motion acting portion 43 of each urging device 42 comes to the summit 55d of the rising slope surface, the slide support member 40 of each urging device 42 is pivoted to a most upward orientation. In this orientation, the distal end portion of the slide support member 40 of each

urging device 42 keeps restraining the corresponding action-receiving portion 61.

At this time, the register roller 12a contacts the register roller 12b. The register rollers 12a, 12b move together while contacting each other as the process unit 2 is pushed further inward.

As the process unit 2 is pushed further inward, the shaft 13a of the photosensitive drum 13 is set to a predetermined position in the inward end portion 55c. At this position, an operator releases the process unit 2 from the operator's hands, so that the process unit 2 is set by its own weight into a state such that the register roller 12a is placed on the register roller 12b, as shown in Fig. 21. The bearings 700, 710 fitted at each end of the register roller 12a are pressed by springs 45, as shown in Fig. 31. Consequently, the register roller 12a presses against the register roller 12b at the appropriate position, angle, and pressing pressure.

When the process unit 2 is set into the body housing 1, as shown in Fig. 21, the distal end of the slide support member 40 of each urging device 42 presses the corresponding action-receiving portion 61. Therefore, the developing roller 22 is pressed against the photosensitive drum 13 by the urging devices 42 and the action-receiving portions 61.

In the state such as shown in Fig. 21, and as further shown in Fig. 9, the bearings 35, vertically movably supporting the shaft 14a of the transfer roller

14, are raised by the shaft bearing raisers 34 that are urged by springs 33, so that the transfer roller 14 is moved upward to press the photosensitive drum 13 at a predetermined pressure.

As described above, as the process unit 2 is removed from the body housing 1, the register roller 12a is not fixed and instead freely moves up and down. The register roller 12a is positioned so as to press against the register roller 12b at the appropriate position, angle, and pressure only after the process unit 2 is set in the body housing 1. The accuracy of the position, angle, and pressing pressure of the register roller 12a with respect to the register roller 12b is determined by the springs 45 disposed on the body housing 1. Therefore, even when the process unit 2 is replaced, the relationship between the register rollers 12a, 12b can be appropriately maintained. Consequently, the sheet P can be constantly and stably conveyed.

The positioning of the register rollers 12a, 12b is performed with respect to the bearings 700, 710. The bearings 700, 710 are fitted to the register roller 12a so as to be spaced from each other at a distance that is longer than the width of the process unit 2, and are provided so as to extend outwardly from the side surface of the process unit 2. Therefore, the positioning of the register roller 12a is performed at each side surface of the body housing 1. When the process unit 2 is attached to or detached from the body housing 1 from the front

face thereof, the springs 45 for positioning the register roller 12a are unlikely to interface with the path of the process unit 2 during the setting or removal thereof, so that the process unit 2 can easily be set into, and removed from, the body housing 1.

The register roller 12a is a shaft made of metal. While the rigidity of the register roller 12a is adequately maintained, the upper register roller 12a, which is longer than the width of the sheet P, is mounted to the process unit 2 via a simple structure. Therefore, cost reduction can be achieved.

As shown in Fig. 1, a sheet guiding opening 80, to guide the sheet P to the contact portion between the photosensitive drum 13 and the transfer roller 14, is provided on the case 30 adjacent to the register roller 12a. With the sheet guiding opening 80, the sheet P is smoothly conveyed to the contact portion between the photosensitive drum 13 and the transfer roller 14.

It is to be understood that the invention is not restricted to the particular forms shown in the foregoing embodiment. Various modifications and alternations can be made thereto without departing from the scope of the invention.